COST AND MANAGEMENT

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By Louis L. Miller

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By John R. McPhee

Homogenizing Factory and Office Thinking . . .

By Henry G. Lykken, Jr.

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OCTOBER, 1957

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Cost and Management

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APPLICATION OF REGRESSION METHODS TO COST ANALYSIS
By Louis L. Miller 346

Mr. Miller is currently Assistant Secretary of Acacia Mutual Life Insurance Co., Washington, D.C. He holds the degrees B.Sc. in Business Administration (Kansas University) and M.A. in Actuarial Science and Statistics (University of Michigan). He has been associated as an actuary with the Kansas State Insurance Department; as Comptroller of Moe Bros. Mfg. Co., Ft. Atkinson, Wisc., and was Vice-President of the Kansas Farm Life Insurance Co. He is a member of the National Association of Cost Accountants, the American Statistical Association and the Institute of Management Science.

ACCOUNTING SYSTEM FOR A FOLDING CARTON COMPANY
By John R. McPhee 356

At present Managing Director and Secretary-Treasurer of Dover Industries Limited, Hamilton, Ontario, Mr. McPhee joined a subsidiary of the company, Robinson Industries Limited, Hamilton, as an accountant in 1949. He is now Vice-President and Secretary-Treasurer of Robinson's, Secretary-Treasurer of the Filey-Hall Paper Box Co. Ltd., Toronto, Secretary of the T. H. Taylor Co. Ltd., Chatham, and Secretary of S. J. Cherry and Sons Ltd., Preston. Mr. McPhee is a Registered Member of the Society of Industrial and Cost Accountants.

HOMOGENIZING FACTORY AND OFFICE THINKING
By Henry G. Lykken, Jr. 370

Mr. Lykken is Comptroller of the Minneapolis Division of Minneapolis-Honeywell Regulator Company. Prior to 1951, he was associated with Montgomery Ward & Co. as Chief Industrial Engineer and Merchandise Manager. He holds the degrees B.B.A. and B.M.E. from the University of Minnesota and is a member of the National Association of Cost Accountants, Comptrollers Institute, Minnesota and National Society of Professional Engineers, and the Association for Business Budgeting.

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Editorial Comment . . .

THE RACE FOR SURVIVAL

For bold souls this is probably the most adventurous decade of history. Breakthroughs in science have become almost commonplace—supersonic speeds, atomic fission, and now satellite moons. It is as though the science fiction of yesteryear had become the reality of today. But it is not exactly as the fiction writers visualized it, for the distressing fact is that western civilization no longer enjoys a monopoly on such breakthroughs.

No doubt, for reasons of prestige and scientific knowledge, the western world will make an all out effort to match the success of the Russian satellite. Additional scientists will be recruited and a crash programme initiated to get the American satellite in the air—and it will succeed. But in the meanwhile, it might be beneficial for those of us on the sidelines to ponder the implications of the Russian breakthrough.

Why, if the Americans and Russians had about the same time to develop their satellites, did the Russians get theirs in the air first? One answer is that the Russians are training more engineers than the U.S. and are employing them in more strategic capacities. Last year, for instance, it was estimated that the Russians were training 280 engineers per million population; the U.S. 136, and Great Britain 57. When these young engineers graduate, moreover, they must accept direction for three years into employments for which they have been trained; thereafter they are freer to make their own choice. This practice may smack of totalitarianism, but since the students are admitted to the universities on the basis of scholastic standing and over 80% of them are on scholarships including board and allowances, the Russians can succeed in placing their best brains in those places where the need is greatest.

Our possibilities of success, on the other hand, are more restricted. Only 75% of the above average brain power achieves the necessary university entrance standing; the other 25% drop out between grades X and XII. Of the 75% who reach university entrance, an unknown but probably significant percentage do not avail themselves of the privilege because the financial sacrifice, in the absence of a widespread and generous system of bursaries and scholarships, is too great—a cost, as estimated in the U.S. in 1951, of $10,000 for a bachelor's degree, $11,000 for an engineer's, and $15,000 for a doctorate.

Obviously as a society we will have to do better than this. We will have to consider how some sizing can be added to the high school curriculum so that above average students will not be bored. By the time such students will have reached university entrance, furthermore, we will have to have resolved the problem of encouraging and facilitating the continued education of the best students.

This, in the writer's view, is the way to cope with the Russian technological challenge. But in the rush to outdo the Russians technically, we run the risk of losing the race for survival as a free

democratic community. The Russian breakthrough, for example, was only achieved at a tremendous cost in terms of human liberty and dignity, typified by Stalinist repression, and by denying a generation of consumers in Russia the standards of housing, clothing, and material possessions that an economy with a per capita output exceeding that of France is capable of providing.

If the western world is to vanquish the Russian challenge, it must devote an equal or even greater amount of resources to education and research. The problem will be to do this without causing such a decline in the material standards of living as to lead to social unrest, for this is the route to dictatorship. To avoid such a route, increased education and research must be sustained through the other sectors of the economy continually improving their productivity.

Happily the forecasts to 1980 regarding improved productivity in Canada are encouraging. The Gordon Commission predicted that Canadian productivity will increase at a rate between 2¾ and 3¼% per annum for the next 25 years. This rate, which is the average rate of productivity increase since the end of the war, is really quite modest when compared with the Russian rate of something over 6%, but there are good reasons for expecting this latter rate to decline in the future. Forecast productivity, coupled with a growth in population to 26 million, will result in the national income of Canada tripling by 1980 to some 80 billion dollars.

It will be a challenge to the industrial accountant, and to management in general, to help make these vital forecasts come true. The survival of our way of life is at stake, and the industrial accountant is going to find himself in the front line of the struggle. Today, for instance, economists are talking about a New Economics, one which regards the managerial process as the administration of resources. The accountant, through his "Return on Investment Analyses" and the post-audit of such investments after they have been made, is in a pivotal position regarding such administration.

Similarly, as activity expands and national income grows, a growing proportion of the labour force is going to be employed in the sector of wholesaling, retailing, communications, transportation and services. Whereas about 32% are so employed today, by 1980 it is estimated that 40% will be thus employed, although the portion of the national income will remain a constant 33%. In other words, it is anticipated productivity growth in the service industries will lag. This then is the area of greatest challenge for the accountant.

He will not only serve his profession but also his country, if he can effectively extend his techniques of standard costing and variances analyses as developed for the tangible products of manufacturing to apply to the intangible values created by the service industries.

As those who read "Accounting Research in Canada" in last month's issue will recall, S.I.C.A. has been anxiously concerned for some time about the accounting profession making a constructive

response to its challenge. To facilitate the effective use of brainpower, for instance, in addition to our correspondence method we have been offering our courses by lecture through an increasing number of universities and affiliates across the nation. Today, as a result, no Canadian of proven ability who aspires to be an accountant lacks access to training facilities. In almost every centre of over 50,000 population, moreover, such students have a choice of instruction by correspondence or lecture method.

We are equally concerned that our students should be prepared to cope not with what happened in the past but with what is likely to occur in the future. To this end the Educational Foundation of S.I.C.A. has been busily occupied the past several years in studying business trends and the accounting skills they are likely to accentuate. Its conclusions have been incorporated into the new R.I.A. curriculum announced last summer, a curriculum which, we hope, will make an effective contribution to the race for survival.

OBITUARY

With deep regret we announce the death of John Alvin Tupper, a former national president and charter member of the Society, who died in Edmonton on September 18th. He was 53.

Mr. Tupper, a chartered accountant, was owner and president of the Sunland Industries Limited. A resident of Edmonton for 30 years, he had worked long and devotedly for the Edmonton Chapter and the Society. He was chairman of the Edmonton Chapter prior to its 1944 inception and first president of the Alberta Council. He also did extensive work on the educational courses and on the setting of educational standards. He served as national president of the Society in 1947-8.

He was also active in many other business organizations and had been president of the Alberta branch of the Canadian Manufacturers' Association and third vice-president of the Chamber of Commerce.

The S.I.C.A. of Canada joins with the Edmonton Chapter in extending deepest sympathy to Mr. Tupper's family in their loss.

Medal Winners . . .

Marcel Blais C. J. Taylor P. J. F. Walsh

The Society announces with pleasure the winners of the two national awards for high achievement in the final examinations.

The H. M. Hetherington Gold Medal, given for the highest marks in the Advanced Cost Accounting examination across Canada, was won this year by C. J. Taylor of London, Ontario. Mr. Taylor was also the winner of the A. G. Howey Medal for the highest standing in Ontario in this subject.

Two students tied for the D. R. Harrison Gold Medal, awarded for the highest marks in Canada on the Fundamentals of Cost Accounting examination: Marcel Blais of Shawinigan Falls, Quebec, and P. J. F. Walsh of Cooksville, Ontario. The H. P. Wright Gold Medal for the highest standing in Ontario in this subject, was also won by Mr. Walsh.

Mr. Taylor is a cost accountant with Vanadium-Alloys Steel Canada Ltd., and has also been employed in the accounting departments of Spramotor Ltd. and Kelvinator of Canada Ltd. He commenced the R.I.A. courses immediately after graduating from the H. B. Beal Commercial High School.

A native of Shawinigan Falls, Mr. Blais joined the accounting staff of the Aluminum Company of Canada in 1948. Following a series of promotions, he was recently appointed supervisor of the General Accounting Office of the Shawinigan Fabricating Works.

Mr. Walsh is a cost analyst in the accounting department of Ford of Oakville. Since he emigrated from England in 1951, where he was employed with a firm of chartered accountants, he has held positions with A. V. Roe Canada Ltd., and Orenda Engines Ltd., as a supervisor in the cost department.

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C. & M. Round-Up . . .

By N. R. Barfoot, R.I.A.

LOOKING AHEAD

Direct reduction of iron ore is a possibility. Dreamed of for centuries by metallurgists, there are now two processes close to commercialization. Lower capital costs (50% saving) through elimination of blast furnaces and coking ovens, and independence of the scrap market are chief advantages.

—o—o—

Trading stamps are not making much headway in Canada. Two supermarkets in the Ottawa district have discontinued their stamp plans recently. A good deal of controversy has arisen over the introduction of this gimmick in retailing. It is fairly widespread.

—o—o—

The 8 mm movie camera field is one of the fastest growing markets; 800,000 of them will be sold this year. New developments include a lens that adjusts itself automatically to light conditions.

—o—o—

Immigration this year will be the highest since 1913. 175,000 immigrants were admitted to Canada in the first half and about 100,000 more will arrive in the last half of the year.

—o—o—

New vending machine will be able to handle paper money. Will be on the market in two years.

—o—o—

OF GENERAL INTEREST

Inflation

Prices are again on the move. There are suggestions that cost of living indexes be applied to Workmen's Compensation, Sickness and Unemployment Insurance plans in the U.S.

There is a feeling even in academic circles that we are in a period of permanent inflation and that prices will move up continuously for some time by 2 to 3% each year.

Supply and demand inflation or price inflation through competitive bidding for materials and manpower seems to be less the case than the cost inflation of wages pushing up prices.

The serious part of this inflation picture is that once the trend is accepted as a normal part of the national scene and business decisions are made with that in mind, inflation doesn't creep but runs.

Deflationary forces are excess capacity in many industries and new job applicants which could lessen the power of labour to force wage increases.

—o—o—

ECONOMIC PLATEAU

Certain of the indications available suggest a levelling off in the economy. They are a bit mixed and erratic from month to month, but here they are and you can draw your own conclusions.

Industrial production rate index has been showing small declines each month but still above '56.

Housing of course, has fallen behind badly.

Electrical manufacturers output is running below last year levels.

Excess capacity is evident in many industries, and particularly in the extractive and refining. This means a slowdown in capital spending while the idle plant situation is corrected.

Unemployment is higher and predictions are that it will be more so as we move into the winter.

None of these factors suggest that the Canadian economy is not strong or that the expansion and development period is over.

—o—o—

POWER OF THE ADMEN

A relatively new and extremely powerful force in the commercial world is the advertising agency.

In the U.S.A. $60 per year for every man, woman and child is being spent on product promotion.

The agencies now employ professional sociologists and psychiatrists to probe the surface and subconscious desires and feelings of John Q. Citizen.

There is an Institute for Motivational Research which conducts psychological studies for marketers and ad agencies.

The results of such research are the modern TV, radio and written commercials which first of all makes us discontented with what we already have (known as creating psychological absolescence). Step two is to create an image around the new product related to our desires. Broadcast this wholesale and you have a new product in the hands of the consumer. A new product which is probably intrinsically no better than the previous model or brand.

In any case, this trading on the restlessness and inherent dissatisfaction of the North American Homo Sapiens has pushed G.N.P.'s to astronomical limits.

—o—o—

ON THE PERSONAL SIDE

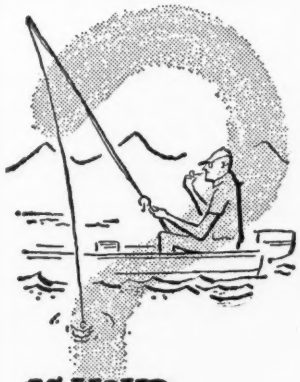
Canadians bought 2.6 billion in life insurance in the first six months of this year. 33% higher than the same period last year.

Here is your average per capita spending a week on various categories of food:

Dairy products	.75c
Eggs	.26
Bakery and cereals	.67
Meat	1.80
Fats and oils	.37
Fruits and vegetables	1.10
Eating out	.62
Total	$5.57

Social Security too costly. Social security benefits payments in the U.S. have overtaken receipts. It is a thought-provoking situation. Perhaps the sum total of all the security for old age and infirmity, State planned hospitalization, etc. cannot be carried by the working force of the country. There is a limit to the bearable load on the taxpayer.

There is one car for every 5.1 people in Canada to-day, compared to 1 car for every 10 in 1947. Total passenger car population 3.2 million.



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PERSONALS

Blair Pitcairn, R.I.A., has received the appointment of Assistant General Manager of North Star Oil Limited, Winnipeg. Mr. Pitcairn was formerly Operations Manager of the company.

L. J. Smitten, a Director of the Toronto Chapter, has been appointed Controller of General Foods, Limited. He was formerly Manager, Budget and Analysis, of the company.

Harold H. Matthews has been appointed Business Manager of the Vancouver branch of White Motors.

R. H. A. Humphries, R.I.A., former chairman of the Vancouver Chapter has been promoted to the position of Accountant in Charge of Construction of the Terminal Construction Co. Ltd., Montreal.

J. Robert Neal, B.Com., C.A., has been named Controller of the Parts and Accessories Division of Ford of Canada. Mr. Neal, a student member of the Toronto Chapter, was previously Assistant Divisional Controller of the Division.

Application of Regression Methods to Cost Analysis . . .

By LOUIS L. MILLER,
Assistant Secretary,
Acacia Mutual Life Insurance Co.,
Washington, D.C.

In this author's estimate, statistical methods of measuring costs compare favorably with conventional methods of analysis and, in many operations, are less costly to apply. In this article he gives examples of how regression methods may be used to solve several cost analysis problems.

LORD KELVIN, one of the great scientific minds of the 19th century, said, "When you can measure what you are speaking about and express it in numbers, you know something about it, but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind." Since cost accounting is primarily concerned with measurement processes, the above quotation causes one to pause and ask whether we are employing the best measurement devices available or whether we are guilty, in some instances, of substituting arbitrary estimates for measured facts.

For example, many plants today, manufacturing multiple lines of products are using uniform rates in the application of burden to product cost. In such cases, burden may be applied as a uniform percentage of direct labour cost, or on some other similar basis. Such a method raises two questions. In the first place, are we justified in assuming that direct labour cost is an appropriate basis for burden absorption? Perhaps it is related, to some degree, to the amount of burden incurred but are there other factors which should be considered?

Consider two departments which are widely different in their composition. One is an assembly operation requiring a relatively large amount of direct labour. The second is highly automized. It may well be that the burden incurred on behalf of both departments is the same, yet the burden absorbed would be very different if labour alone were the base and a uniform rate of application employed.

The second question is whether there is reason to use the same burden rate in both departments, assuming that it is known that labour is a proper base for burden absorption. To the degree that we base product cost on erroneous assumptions we are not measuring costs but estimating them instead.

Regression As A Cost Measurement Tool

It is hoped that the method of measurement presented in this paper will be found both interesting and of practical value in the solution of

1. Space will not permit a complete outline of the theory and application of linear or multiple regression. A clear outline of the method can be found in Appendix C, **Statistical Methods**, Third Edition, F. C. Mills, Henry Holt & Co. as well as in almost any other standard textbook on statistical methods.
2. The complete correlation process, including the establishment of average relationships between two variables by regression, also includes the additional steps of determining the degree of relationship between the variables and the significance of such relationships. Regression, therefore, is only that part of the correlation process which determines an average relationship by mathematical means. Regression is a mathematical process by which the relationships between several independent variables and a dependent variable may be determined if such a relationship exists.

such problems. The method to be discussed is a statistical process known as *linear or multiple regression.*[1] It is a mathematical method for determination of the best *average* relationship which exists between a dependent variable and one or more independent variables. Regression is a part of the statistical process of correlation.[2]. A hypothetical example is, perhaps, the best means of illustrating what is meant by regression and how it works. The example will demonstrate the ability of regression to find a solution to a certain kind of cost problem.

Let us assume that in a given plant, three products, A, B and C, are being manufactured. In the table following, the volume of each of these three products produced during each of six consecutive months are shown in columns 2, 3, and 4. Column 1 shows the total plant burden expense for the individual months. The problem is to determine how much of the total monthly burden cost was incurred on behalf of each of the three products.

TABLE I

Month	Monthly Factory Burden	Number of Units of Products Manufactured Product A	Product B	Product C
1	$134,800	10,000	400	25,000
2	133,200	11,000	600	22,000
3	121,400	12,000	700	16,000
4	110,000	9,000	800	17,000
5	107,800	10,000	900	14,000
6	99,600	8,000	800	15,000
TOTAL	707,400	60,000	4,200	109,000

Application of Method To A Specific Problem

The end product of linear regression will be an equation of the type

(1) $$X_1 = a + bX_2 + cX_3 + dX_4$$

where, in the example, a = fixed monthly burden, b, c, and d are variable unit burdens for products A, B, and C, and:

X_1 = total burden in a given month
X_2 = the quantity of product A manufactured in a month
X_3 = the quantity of product B manufactured in a month
X_4 = the quantity of product C manufactured in a month

If we can find appropriate values for a, b, c and d, to put into the above equation along with the monthly quantities of products A, B, and C, we will have an equation which will give the best possible estimate of the total burden cost for a given month. This will be true only if there actually is a relationship between the monthly volumes of the individual products and the total factory burden. In arriving at values to insert in the above equation we must solve four "normal equations" of the general type set out below.

$$\begin{array}{lllllllll} \text{I} & X_1 & = Na & + b\Sigma X_2 & + c\Sigma X_3 & + d\Sigma X_4 \\ \text{II} & X_1X_2 & = a\Sigma X_2 & + b\Sigma X^2_2 & + c\Sigma X_2X_3 & + d\Sigma X_2X_4 \\ \text{III} & X_1X_3 & = a\Sigma X_3 & + b\Sigma X_2X_3 & + c\Sigma X^2_3 & + d\Sigma X_3X_4 \\ \text{IV} & X_1X_4 & = a\Sigma X_4 & + b\Sigma X_2X_4 & + c\Sigma X_3X_4 & + d\Sigma X^2_4 \end{array}$$

For those not familiar with statistical symbolism, Σ means "the sum of", so that ΣX_1X_2, for example, means the sum of the products of the individual monthly values of X_1 and X_2.

A tabulation of the functions in the four normal equations indicates that we need the following functions computed from the data in Table I. Values computed for each function from data in Table I are also shown.

$N = 6$	$\Sigma X_1X_2 = 7{,}140.200$	$\Sigma X^2_2 = 610.000$
$\Sigma X_1 = 707.400$	$\Sigma X_1X_3 = 484.000$	$\Sigma X^2_3 = 3.100$
$\Sigma X_2 = 60.000$	$\Sigma X_1X_4 = 13{,}126.200$	$\Sigma X^2_4 = 2075.000$
$\Sigma X_3 = 4.200$	$\Sigma X_2X_3 = 41.600$	
$\Sigma X_4 = 109.000$	$\Sigma X_2X_4 = 1{,}097.000$	
	$\Sigma X_3X_4 = 72.600$	

When these functions are substituted into the normal equations, and the normal equations are solved simultaneously, the following values are obtained for the constants, a, b, c and d.

$a = \$5{,}000$	$c = \$12.00$
$b = \$5.00$	$d = \$3.00$

The estimating equation for total monthly burden cost becomes,

$$X_1 = \$5{,}000 + \$5.00\ X_2 + \$12.00\ X_3 + \$3.00\ X_4$$

If we substitute the monthly quantities of A, B and C produced, as shown in Table I, in the estimating equation, we will obtain a value of X_1 (estimated total monthly burden) for the individual months as shown in Table II. Columns 1, 2 and 3 of Table II show the burden values for products A, B and C, respectively, for each of the six months. Column 4 shows the constant burden figure of $5,000 per month. Column 5 shows the total factory burden which agrees exactly with the total burden figures in column 1 of Table I. The result of the regression process has been to break down the total factory burden into the parts generated by each of the products.

TABLE II

COMPUTATION OF MONTHLY FACTORY BURDEN FROM ESTIMATING EQUATION

Month	COLUMN 1 PRODUCT A			COLUMN 2 PRODUCT B		
	Number Units	Unit Burden	Total Burden	Number Units	Unit Burden	Total Burden
1	10,000	$5.00	$ 50,000	400	$12.00	$ 4,800
2	11,000	5.00	55,000	600	12.00	7,200
3	12,000	5.00	60,000	700	12.00	8,400
4	9,000	5.00	45,000	800	12.00	9,600
5	10,000	5.00	50,000	900	12.00	10,800
6	8,000	5.00	40,000	800	12.00	9,600
TOTAL	60,000		300,000	4,200		$50,400

Month	COLUMN 3 PRODUCT C			COLUMN 4	COLUMN 5
	Number Units	Unit Burden	Total Burden	Fixed Burden (Factor A)	Total Factory Burden
1	$ 25,000	$3.00	$ 75,000	$ 5,000	$134,800
2	22,000	3.00	66,000	5,000	133,200

3	16,000	3.00	48,000	5,000	121,400
4	17,000	3.00	51,000	5,000	110,600
5	14,000	3.00	42,000	5,000	107,800
6	15,000	3.00	45,000	5,000	99,600
TOTAL	109,000		$327,000	30,000	707,400

Application of the unit burden rates of $5, $12, and $3 for products A, B and C, respectively, to product cost would leave $5,000 of burden unabsorbed each month. In practice the fixed burden should be allocated to each unit of the three products proportionately. If we assume that the volume of production of the three products during the six months represents "normal" volume for each, then the $60,000 fixed burden would be allocated as follows:

		Percent
Total Burden Product A	$300,000	44.287
Total Burden Product B	50,400	7.440
Total Burden Product C	327,000	48.273
	$677,400	100.000

$$\$30{,}000 \times .44287 = \$13{,}286.10 \div 60{,}000 = \$.220$$
$$\$30{,}000 \times .07440 = 2{,}232.00 \div 4{,}200 = \$.531$$
$$\$30{,}000 \times .48273 = 14{,}481.90 \div 109{,}000 = \$.133$$
$$\$30{,}000.00$$

The unit burden rates for 100% absorption at "normal" volume would be:

Product A: $ 5.00 + $.220 = $ 5.220
Product B: $12.00 + $.531 = $12.531
Product C: $ 3.00 + $.133 = $ 3.133

It must be confessed that the example was "rigged". The total monthly burden was computed by using burden rates of $5, $12, and $3 per unit for the three products and the fixed monthly burden of $5,000 was also assumed. This, however, is not a cardinal sin because by "rigging" the example we can clearly see how linear regression has the ability to discriminate between, and measure the forces exerted by, several variables in producing a composite total when, in fact, such forces are exerted by each of the independent variables considered. In actual practice we will, of course, never find a clean cut situation where the total burden incurred will be exactly accounted for by application of a fixed unit burden rate to the number of units of products produced.

Burden cannot be so perfectly controlled. In the solution of an actual problem we would, accordingly, expect that the estimating equation would rarely, if ever, exactly account for the total burden incurred in any given month. A residual (positive or negative) would be expected. Importantly enough, however, the residual is a measure of the efficiency of control of burden with respect to formula which can be regarded as a standard.

In the kind of an example cited, the major objective was to find the effect of each of the three commodities on generation of total burden. From this, it will be possible to determine whether, for example, a uniform burden rate for all products based on, say direct labour, is appropriate, although space does not permit an illustration of how this may be done.

At this point we have learned that there is a standard or unit burden for each product in the example. We are also interested in learning the source of these unit burden costs for each of the products. To do this we would proceed in the same manner as before except, in this process, we would determine the relationship between the total monthly product burden and such elements of burden as indirect labour, rent, utilities, supplies. The result, however, would be an estimating equation which will break down the standard unit burden into the portions arising from each of the appropriate sources just mentioned.

It is clear, however, that this kind of approach may well disclose that the origin of burden costs and the amount of burden per unit of each product, varies widely from the amounts which would be allocated under arbitrary assumptions.

Outline of Results Achieved In An Actual Situation

It will, perhaps, clarify the principles involved in the use of linear regression to present the results of analysis of an actual cost problem. In this instance there were 60 branch sales office operations, all performing the same class of functions, but in varying proportions. The size of the individual operations differed materially. The problem in this case was to determine a standard cost of operations based on workload factors.

Prior to the study, only one factor had been used as a criterion, and this factor had been chosen arbitrarily. It was meaningless and ineffective and had been disregarded by management for some time prior to commencement of the analysis.

After a preliminary review of the problem it was determined that there were seven measurable factors that logically could be expected to generate workload and operating cost. These seven factors were put into a regression analysis as independent variables to determine the relationship of each to the operating cost of each branch. This required the solution of seven normal equations of the type,

$$X_1 = a + bX_2 + cX_3 + dX_4 + eX_5 + fX_6 + gX_7$$

When the values of a, b, c, d, e, f, and g were determined it was found that four of the factors were not significant, i.e., did not contribute significantly to total cost. These four factors were eliminated and the analysis was rerun using only the three significant factors remaining. The resulting estimating equation was,

(Branch Office Cost) $X_1 = \$3{,}005.00 + \$16.31$ per unit of factor I + $.46 per unit of factor II + $.45 per unit of factor III

Columns 1 and 2 of Table III following show the values computed by the regression equation, and the actual costs for 15 of the 60 branches. Column 3 shows the difference between actual cost and the standard or permissible cost computed by the regression equation.

TABLE III

Branch Number	Costs Computed By Regression Equation (Permissible)	Actual Costs	Actual Over (+) Or Under (—) Permissible
1	$15,211	$13,725	—$1,486
2	7,743	10,721	+ 2,978
3	12,746	8,250	— 4,496
4	23,099	21,662	— 1,437
5	17,018	16,225	— 793
6	15,177	17,601	+ 2,424
7	15,982	14,762	— 1,220
8	31,997	50,182	+18,185
9	11,700	13,575	+ 1,875
10	13,069	10,957	— 2,112
11	10,708	9,757	— 951
12	9,666	10,612	+ 946
13	5,125	6,100	+ 975
14	13,044	13,953	+ 909
15	16,573	15,960	— 613

Isolation of Magnitudes and Sources of Workload Variation

Although all of the 60 branches were engaged in performing the same general functions, there were found to be differences in operating costs due to such things as average size of sale, collection expenses, account service cost, etc. These workload cost variations were recognized by the regression formula. To determine how much these variable factors affected cost, we need only determine *average* unit costs, apply these averages to the volumes of functions performed in each branch, and compare the average costs with the permissible costs determined from the regression equation, which takes into account the workload and cost variations arising out of variations in average size sales, collection expense, etc. The permissible and average costs and the difference between the two for the 15 branches are shown in Table IV following. The difference column is the important one. It reflects variation in sales cost which arise out of the character of the market being served. In the case of this actual example, regression analysis has made it possible to break down the difference between actual and average cost of operating a sales branch into two components which form the basis for important management decisions. The difference between actual and permissible cost must be considered as variations that are controllable, in the usual sense. This difference is an index of the efficiency of cost control, or, perhaps, when actual is far below permissible, it represents a "starvation", or neglect, of the branch.

The difference between permissible cost and average cost is a difference which arises out of characteristics of the market being served. It may or may not be a difference that is controllable. If a better clientele exists in the market area than that which is being currently served, this difference represents a managerial weakness in that the best available clientele has not been cultivated. It may be, however, that the particular operation is being carried on in a low grade market. In this case, reduction of sales costs represented by the difference between permissible and average costs is out of the question. Management must, therefore, face up to the problem of whether it is wise to continue the particular sales branch or whether an equivalent expenditure of money should be spent in a more favorable market area.

TABLE IV

Branch	Permissible Cost	Average Cost	Permissible Over (+) Or Under (—) Average
1	$15,211	$13,978	+$1,233
2	7,743	7,134	+ 609
3	12,746	12,191	+ 555
4	23,099	23,052	+ 47
5	17,018	11,754	+ 5,264
6	15,177	16,485	— 1,308
7	15,982	13,423	+ 2,559
8	31,997	37,584	— 5,587
9	11,700	11,074	+ 626
10	13,069	11,219	+ 1,850
11	10,708	9,316	+ 1,392
12	9,666	9,053	+ 613
13	5,125	4,783	+ 342
14	13,044	12,354	+ 690
15	16,573	16,735	— 162

The foregoing example illustrates the important fact that regression analysis can be employed profitably in many cost analysis problems, particularly those which require the analysis of several factors at one time. It provides a degree of accuracy far surpassing "rough and ready" methods or arbitrary judgment. To the degree that it improves the ability to measure things as they actually exist, it produces a corresponding improvement in the quality and usefulness of cost accounting as a management tool.

Application of the Regression Method to Individual Cost Elements

The story has not yet been fully told. Obviously, even more useful information can be obtained if the actual classification of expenditures in each sales branch office is analyzed by linear regression to determine the factors which control each cost element. This was done in the actual problem now being discussed. The accounting classification of expenses in the branch offices were as follows:

salaries
rent
postage
telephone exchange service
telegrams
toll calls
miscellaneous

Each of the foregoing accounts, for each of the 60 branches, was analyzed by linear regression to determine estimating equations based on appropriate workload factors. Due to variations in rental rates and salary scales by geographical areas, it was deemed inadvisable to develop estimating equations on a dollar basis for salaries and rent. Accordingly, equations were developed to estimate the numbers of clerical personnel required and the square footage of space needed. Table V shows the amounts computed by the several estimating equations for each of the cost elements for the 15 branches cited previously. The total of these individual cost elements for each branch are shown in column 7. In arriving at the cost for clerical personnel and rent, company-wide average clerical salary rates and rental rates per square foot were used.[1]

TABLE V

Branch	Rent	Clerical Personnel	Telephone Exchange	Postage	Telegrams and Tolls	Miscell. Expense	Total Cost by Formula
1	$3,848	$ 9,546	$ 716	$ 431	$182	$218	$14,941
2	2,674	4,773	407	232	101	121	8,308
3	3,782	7,643	670	385	156	187	12,823
4	6,032	15,037	1,248	902	290	348	23,857
5	3,880	10,513	633	375	193	231	15,825
6	4,402	9,546	932	616	194	233	15,923
7	4,076	10,264	703	383	193	231	15,850
8	7,337	21,744	1,707	1,527	391	470	33,176
9	3,685	7,175	583	349	147	177	12,166
10	3,456	8,610	586	333	162	195	13,342
11	3,456	6,208	539	271	131	157	10,762
12	2,869	5,740	496	313	118	141	9,677
13	2,837	2,402	276	68	70	84	5,737
14	3,880	9,078	731	467	177	212	14,545
15	4,793	11,231	922	559	219	263	17,987

Table VI following shows a comparison between permissible and average cost, as computed previously and shown in Table IV, with the allowable costs computed from the several estimating equations (one for each cost element). Costs computed by the several individual cost formulae will, hereafter, be referred to as cost computed by the "direct method".

TABLE VI

Branch	Permissible Cost	Average Cost	Allowable Cost (Direct Method)	Actual	Actual Less Allowable
1	$15,211	$13,978	$14,941	$13,725	—$1,216
2	7,743	7,134	8,308	10,721	2,413
3	12,746	12,191	12,823	8,250	— 4,573
4	23,099	23,052	23,857	21,662	— 2,193
5	17,018	11,754	15,825	16,225	400
6	15,177	16,485	15,923	17,601	1,678
7	15,982	13,423	15,850	14,762	— 1,088
8	31,997	37,584	33,176	50,182	17,006
9	11,700	11,074	12,166	13,575	1,409
10	13,069	11,219	13,342	10,957	— 2,385

1. It is a distinct advantage of the method of regression that the variables need not be in like units.

11	10,708	9,316	10,762	9,757	— 1,005
12	9,666	9,053	9,677	10,612	935
13	5,125	4,783	5,737	6,100	363
14	13,044	12,354	14,545	13,953	— 592
15	16,573	16,735	17,987	15,960	— 2,027

It will be seen that there is very close agreement between permissible costs and those computed by the direct method. It should be stated at this point that for cost control purposes, the direct method gives the most accurate estimate of costs which should be allowed, since study of the individual elements, rather than totals, permits greater flexibility to the regression process and therefore, results in greater precision of measurement. An additional advantage is that the direct method permits a much greater degree of detail in the analysis of cost variances. This means better cost control is possible. In Table VI it will be noticed that there is an extreme variation between actual cost for branch 8 and the cost allowance computed by the direct method. Table VII illustrates the analysis of the cost variance for this sales branch, based on standards (allowable cost) computed by the direct method.

Analysis of Cost Variance

TABLE VII

An Example of Method of Analysis of Variation of Branch Office Expense From Allowances Computed by Formulae

I	Total Actual Cost	$50,182
	Total by Formulae	33,176
	Total Variance	$17,006

II	Breakdown of Total Variance ITEM	ACTUAL	FORMULA	VARIANCE
	Rent	$12,574	$ 7,337	$ 5,237
	Clerical Salaries	32,477	21,744	10,733
	Telephone Service	2,602	1,707	895
	Postage	1,261	1,527	— 266
	Toll Calls—Telegrams	270	391	— 121
	Miscellaneous	998	470	528
	TOTAL	$50,182	$33,176	$17,006

III Analysis of Rent Variance

	Area (sq. ft.)	At Lease Rate	At Co'y Norm	Percentage of Square Footage
a. Total under lease	3,125	$12,574	$10,188	100%
b. Space required by formula (including provision for branch growth—basis of lease)	2,670	10,680	8,704	85.4
c. Lease variance (departure from normal requirement)	455	1,894	1,484	14.6
d. Space required by present organization	2,240	8,960	7,337	71.7
e. Utilization variance Item b—Item d	430	1,720	1,367	13.7
f. Total variance at lease rate	885	3,614	2,851	28.3
g. Rental rate variance	....	1,623	2,386	.....
h. Total rental cost variance	....	5,237	5,237	.....

IV Clerical Personnel

	ACTUAL	FORMULA	VARIANCE
a. Clerical Salaries	$32,477	$21,744.00	$10,733
b. Number persons employed	10.5	6.97	3.53
c. Average rate	3,093.05	3,119.66	—26.61
d. Variance due to rate (10.5 x —$26.61)	....	....	—279.00
e. Variance due to numbers of personnel (3.53 x $3,119.66)	....	....	11,012.00
f. Net variance	....	....	10,733.00

The analysis of cost variance illustrated is conventional, with the exception that the cost standards employed were arrived at by regression methods. The observant reader will perhaps have decided that the regression method produces standards which are the result of applying an averaging process to existing cost levels, be they good, bad, or indifferent. Thus the standards arrived at by this process are not necessarily appropriate standards. This is true—but not as serious as it sounds. For example, among the 60 sales branches studies, substantial variations were disclosed between actual and allowable cost. These variations were both above and below standard. Those operations that are successfully performing their functions at less than standard cost, become the models for adjustment of the factors in the estimating equation to bring the company-wide standard in line with appropriate levels.

It can also be stated that the use of conventional methods engineering techniques will arrive at similar but better results. This is a valid argument. The author believes, however, that the difference in results between the two methods is too small to justify the difference in the cost of standards development in non-repetitive functions such as those involved in clerical operations. This belief is founded upon the highly satisfactory results achieved during the past two years in the actual use of standards established by the regression process.

FOR FURTHER READING

A REVIEW OF STATISTICS IN RELATION TO COST ACCOUNTING, by R. Glendinning, The Cost Accountant, April 1954.
STATISTICAL METHOD, by Colin A. Perry, The Accountants Journal, March 1957.
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Accounting System for a Folding Carton Company . . .

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Formulating an operating plan and following it at all times through the wise use of cost accounting, adequate control and intelligent statements, reports and analyses is essential to the good conduct of any business. In this article the author describes how these principles are incorporated into the accounting system of his company, a medium-sized company manufacturing folding paper cartons.

FOLDING cartons have become so much a part of our everyday life that we tend to take them for granted, like electricity or running water, without considering how much effort went into making them everywhere available, at any time. Every day most Canadians have their hands on a folding carton—or folding paper box as it is sometimes called. Perhaps it contains breakfast cereal or cigarettes, soap or cake mix.

The folding carton, besides being an effective advertising medium, is a guardian of its contents, protecting against breakage, spoilage, contamination, and many other hazards, enroute from the manufacturer to the consumer's shelf.

Processing the Product

The key process in the manufacture of folding cartons is cutting and creasing. In this process the sheets of paperboard are cut to the shape of the carton desired and creases are made where the carton is to be folded. In some instances this is the sole operation, as unprinted folding cartons of a style which does not require glueing are reproduced from sheets of board and shipped to the customer without further treatment. Normally the cutting and creasing follow the printing and precede the glueing.

The initial step is preparation of a layout. Once the layout (which determines the arrangement of the cartons on a sheet of board) is determined and approved, the raw materials and printing plates are ordered. Work is also begun on a cutting and creasing die.

If the folding carton design calls for more than simple copy, which can be set from type, an engraving or master plate is necessary. Engravings can be used as printing plates, but if a large quantity of folding boxes is required—or if there is any possibility of additional quantities being purchased in the future—the engraving should be duplicated in the form of an electrotype, which is a less expensive copy. The engraving can then be retained as the master plate without being subjected to the wear and tear of printing.

When the paperboard ink and electrotypes have arrived at the plant, the folding carton manufacturing process is ready to begin. Skilled pressmen place the electrotypes on the printing press accurately,

so that they will register perfectly with the die on the cutter and creaser, and with the electrotype of the next colour to be applied. The sheets of paperboard are then run through the press and printed. Next, the printed sheets are processed through the cutting and creasing machine, where the cartons are formed into the required shape. The carton is then waxed, if necessary, as in the case of cartons for ice cream bricks.

The final operation is to glue the cartons and pack them in corrugated cases for shipment.

Practically all of the cartons are manufactured to the customer's specifications. For this reason we find that job cost accounting is the most suitable for this type of operation. The following is a description of a job cost system used by a medium-sized company manufacturing folding cartons.

Type of Cost System

Various types of cost systems or adaptations of them will no doubt work equally well in a folding carton industry. We shall deal here with a job cost system which will produce accurate costs with a minimum of clerical work. Raw materials are priced at average laid-down costs. There is no cost or factory ledger and therefore all accounts are kept in the general ledger.

When an order has been obtained, it is first passed to the credit department for approval of credit. Then it is scrutinized by the order department to ascertain that all specifications are complete to the last detail and not ambiguous. A production order (Exhibit "B") is then prepared, with all the specifications necessary for manufacturing and accounting purposes. Eight copies are made and issued as follows:

1. Acceptance of order which is mailed to the customer.
2. Salesman's copy.
3. Production order which is attached to docket.
4. Office copy which is used for invoicing, etc.
5. Copy of production order which is kept by production manager.
6. Shipper's copy.
7. Finishing department copy.
8. Production scheduling copy.

The production order, which has been attached to a large kraft envelope called a docket, is then passed on to the production planner where the order is scheduled and any necessary material requisitions are made out. These requisitions are then passed on to the purchasing agent. At this stage, it may be necessary to prepare or change drawings of the printing and to order engravings or electroplates to provide a complete set of printing plates.

The order is then ready to go into production, as and when scheduled, dependent of course upon the delivery of any special materials which have been ordered.

When the order is completed, it is passed to the shipping department, where it is either placed in storage or shipped to the customer, depending on the required delivery date.

When it is to be shipped, the shipper prepares the bill of lading and labels from instructions on his copy of the production order. A copy of the bill of lading is then forwarded to the invoicing department, where the necessary invoices are prepared and mailed to the customer.

Purchasing

A book of requisition forms is placed in the hands of each foreman or other person authorized to requisition purchases. The forms are made out in duplicate, one copy remaining with the requisitioner and the original being sent to the purchasing department after being approved by the superintendent or production manager. The requisition form is very similar to the purchase order and this facilitates typing of the purchase order.

A purchase order (Exhibit "A") is then typed from the approved requisition. Purchase orders are made out in quintriplicate and are issued as follows:

1. Supplier's copy.
2. Office copy which is filed numerically.
3. Receiver's copy No. 1 which is returned to office on receipt of goods.
4. Receiver's copy No. 2 which is kept permanently by receiver.
5. Requisitioner's copy, which is given to requisitioner in order that he will know that the goods are on order.

Receipt of Raw Materials

A perpetual inventory is kept on all items of raw materials. The raw materials arriving from the various suppliers are accepted by the shipping and receiving department. The receiver checks the goods received with a copy of the purchase order. When he is satisfied that the materials are as ordered, a receiving memo is prepared in duplicate showing the date received, quantity or weight and type of goods received. This receiving memo is actually a copy of the purchase order which was sent to the receiver in duplicate when the goods were ordered. A copy of this receiving memo is sent to the accounting department.

When the supplier's invoice is received, the invoice is stapled to the combined receiving slip and purchase order which was returned by the receiver. After verification of the invoice, the quantities are then entered on the perpetual inventory cards.

Cost Accounting

In this job cost system a production cost summary (Exhibit "C") is made out for each job. Entries for material, labour and overhead are

posted to this summary sheet. These summaries form the work in process ledger and are controlled by the labour and overhead in process control account in the general ledger, which is posted from summaries of the charges to individual cost summaries.

Material records are maintained on perpetual inventory cards. The records are controlled by a raw material inventory control account in the general ledger. Postings are made to this account from the summary of materials used and from the voucher register. Manufacturing expense accounts, including labour, are classified in the general ledger.

Most jobs are made to customer's order and are therefore transferred directly from work in process to cost of goods sold. There are some items which are put into stock to be shipped at a later date and these are transferred from work in process to a finished goods account until shipped. The record of finished goods is also kept on the same type of cards as the raw materials.

A machine hour rate for each machine is used as a basis for charging manufacturing expenses other than material to the production cost summary. The machine hour rate is the cost of operating a machine for one hour under normal conditions. The number of hours spent by each machine on a certain job is ascertained from the time cards and posted to the production cost summary daily. At the end of the month, the total manufacturing expense on the above basis is debited to the labour and overhead in process account and credited to applied manufacturing expense from a summary of the production cost summaries.

On completion of an order, selling and administrative costs are charged to the production cost summary on the basis of a percentage of all material and manufacturing costs. The freight costs are charged to the production costs summary if the order has been shipped prepaid.

Now all the costs applicable to the order have been charged and the cost per thousand cartons can be arrived at. The profit per thousand and the percentage of profit are also noted on the production cost summary.

Direct Material Accounting and Control

All stock received is kept in the storeroom and is issued on receipt of properly authorized requisitions. Bin record cards are kept, showing quantities received and issued.

When special materials are required for customers' orders, purchase requisitions are made out by the production department. As standard materials get down to minimum levels, purchase requisitions are issued by the stock control clerk for the quantities to be ordered. These requisitions are made out in duplicate, with one copy being passed on to the purchasing department.

Purchase orders are then made up in quintuplicate, one copy of which is sent to the clerk requisitioning the materials. When the material is received, checked and entered on the receiver's copies of the

purchase order, one of the receiver's copies is passed on to the purchasing department. When the invoices arrive in the purchasing department they are verified and the receiver's copy of the purchase order is attached to the customer's invoice. The invoice is then passed on to the material control clerk, who enters the material on the perpetual inventory card. Then the invoices are forwarded to the accounts payable clerk for payment.

Requisitions for issues of stock to production are made out by the production control clerk in triplicate. One copy of this form is kept by the issuing clerk, and the others go to the stockkeeper and cost accountant. The stockkeeper then issues the materials and this copy accompanies the materials and is placed in the docket which accompanies all orders through the various stages of production. The cost accountant's copy is the basis for the entry recording the issue on the perpetual inventory record and on the summary of materials used. These requisitions are issued for the actual amount of stock needed for the job. There is an allowance for normal spoilage. If more stock is required, an additional requisition is prepared but if all the stock is not required, a returned to stock memo is made out by the foreman in triplicate, with copies going to the stockkeeper and cost accountant and one being kept in the docket.

Spoiled or obsolete stock is reported by the factory superintendent and this is taken from the perpetual inventory cards and credited to raw material control and debited to materials used.

Periodically a physical count is made on the raw material stock. This count is checked with the perpetual records and any discrepancy is carefully checked. An adjustment in the books is made for any differences in a similar manner as for obsolete stock.

Machine Hour Rate

The machine hour rate is the total cost of the direct labour and factory overhead required to operate a machine for one hour. The different machines in the plant for which there are machine hour rates are as follows:

Machine No.	Type
1.	Meihle Single Colour Press
2.	Meihle Single Colour Press
3.	Meihle Two Colour Press
4.	Miller Two Colour Press
5.	Meihle Single Colour Press
6.	Kluge Single Colour Press
7.	Platen Cutting and Creasing Press
8.	Platen Cutting and Creasing Press
9.	Platen Cutting and Creasing Press
10.	Meihle Cutting and Creasing Press

11. Miller Cutting and Creasing Press
12. High Gloss Waxer
13. International Gluer
14. Ripcord Machine
15. Guillotine
16. Brightwood Gluer
17. Punch Press
18. Cellophane Machine
19. Satin Finish Waxer
20. Right Angle Gluer

There is also a machine hour rate for male handwork and female handwork.

The total of the manufacturing expenses other than direct labour and depreciation for all the departments is compiled when the budget for the year is made up.

A forecast is then made of the total man hours required to operate all the machines and hand work departments for the coming year. In a case where two men are required to operate a machine, the man hours would of course be double the machine hours of the machine. By dividing the manufacturing expenses by the man-hour costs forecast we arrive at the burden rate for manufacturing costs not including direct labour and depreciation.

The depreciation charged to a particular machine per hour is arrived at by dividing the depreciation for the year for the particular machine by the forecast number of hours that it is expected to operate. The direct labour in the machine hour rate is the average for the employees operating a particular machine.

Machine Hour Rate for No. 3 Meihle
Two Colour Press (Operated by 2 Men)

Manufacturing Expense 2 x 2.00	$4.00
$100,000.00 (*Dept. Total for year*) =2.00 per man hr.	
50,000 (Total man hours for all machines)	
Depreciation	$2.00
$4,000.00 (*Depreciation for year for No. 3 Press*) =2.00 per machine hr.	
2000 (machine hours for year for No. 3 Press)	
Direct Labour	$3.00
Pressman (Average Rate $1.80)	
Assistant (Average Rate $1.20)	
MACHINE HOUR RATE	$9.00

Due to the fact that some machines are worth as little as a few hundred dollars and other printing presses may cost as much as $250,000 or more, we have kept the depreciation separate from the other manufacturing costs. Another reason is that the handwork department should not include depreciation for machinery.

In the past we have built up our machine hour rates on a much more detailed basis but we find that the results from the above method are very close to the more detailed method.

Payroll and Time Recording

When the employees enter and leave the plant time cards are punched. Job clocks are conveniently situated in the production departments. When the employee starts a job in the morning he punches the job card. Therefore, as he completes each job, he punches his card and marks in the order number, customer's name, machine number, quantity of production and also the operation he has completed.

The difference between the finish time for one job and the finish time for the next job is the time spent on that particular operation. The job clocks record the hours in tenths to simplify calculation. Only one card is required to be filled in each day per person. Time spent on non-productive operations such as oiling, washups and repairs is also recorded.

The time spent on all operations is then posted to the production cost summary, on the back of which there is space to accumulate the time spent on each operation from day to day. When the job is completed, the total hours for each operation is brought forward to the front of the summary.

The time card which records the employee's starting and finishing time each day for a week is used to compile the gross wages for the week. These cards are checked against the daily cards punched at the job clocks. The employees' wages are made up weekly and the extension for the gross pay is made on the time card. The payroll sheet is then made up, with the various deductions which are necessary. At the same time as the payroll sheet is written up, the employee's cheque and earnings record are completed in one writing. The cheque stub, which is actually a copy of the payroll sheet entry, shows all the deductions which are made.

Month End Journal Entries

A columnar general journal is used as most of the entries are repeated every month.

Raw materials received during the month are accumulated in the raw material control column in the voucher register. Power, insurance, repairs, etc., are accumulated similarly in their column in the voucher register.

All manufacturing expenses have accounts in the general ledger and therefore all expenses for the month are posted directly to their proper accounts in the general ledger from the totals in the voucher register.

Every month a standard percentage of labour cost is computed to take care of employee vacation and public holiday pay. The entry is

Dr. labour—Cr. reserve for vacations. When payment is made for vacations or legal holidays, the reserve account is debited.

Any inventory adjustments during the month are charged or credited to raw materials control and the proper entry made to materials used. Issues of raw materials are not removed from the raw materials control until the order is completed and then they are charged directly to materials used. The total of materials used is obtained from the summary of orders completed during the month. The following entries are made for orders completed during the month:

Cost of Goods Sold Dr.
Finished Goods Dr.
Labour and Overhead in Process Cr.
Materials Used Cr.

The labour and manufacturing expenses charged to production orders each month are recorded on a summary of production orders. This total is debited to labour and overhead in process and credited to applied labour and overhead. An adjustment is set up so that the labour account will reflect the total labour cost for the months.

With expenses such as Unemployment Insurance, Workmen's Compensation, Plant Insurance, the expense account in the general ledger is debited with the charge for the month and the nominal account is credited.

Depreciation is debited and reserve for depreciation credited monthly for the plant and machinery.

There is no material in process.

Analysis of Variances

(Applied Labour and Overhead)

The over or under applied labour and overhead expense is analyzed into expense, capacity and efficiency variances.

The expense variance is the difference between the total actual cost center expenses for the month, as compared with the budgeted expense for the month.

The capacity variance is arrived at by comparing the budgeted expense for the month with the product of the actual hours and the machine hour rate. This variance shows the under or over absorbed cost for the period, which is due to capacity being above or below normal. An analysis is made of these variances to determine whether they are due to the sales department not bringing in sufficient orders or whether they are due to poor planning.

The efficiency variance shows the cost of excess hours needed for the period's production, or the saving from completed production in less than the estimated required number of hours. The method of computing the variance is to determine the difference between the net allowed hours and the actual hours for the month and multiply by the machine hour rate.

Budgets

A static budget is maintained. The Secretary-Treasurer of the firm is the chief budget officer. Previous to the beginning of the fiscal year, the following year's budget is drawn up.

As a large percentage of the sales are for special order and as this industry is very competitive, it is difficult to establish a sales budget. Nevertheless, salesmen are required to co-operate with the sales manager in establishing a sales budget. Sales are budgeted by territories and products.

From the sales budget, the production budget is established. From this the budget for labour, materials and other variable costs is established. The fixed costs are then budgeted.

The financial budget is also drawn up and plans are made to borrow money, if it is required for financing at certain stages during the budget period.

The budget figures are used to draw up an anticipated profit and loss statement and balance sheet. The budget figures are then compared month by month with the actual and action is taken where it is advisable.

If it becomes apparent during the year that conditions are different from those forecast and that the budget is going to lose much of its value as a measuring stick, the whole budget is revised, with existing conditions being taken into consideration.

Estimating

The estimator computes the cost of production for all quotation requests and orders which are received. The estimates are made up on the same sheets as are used for compiling costs.

Whether for an order or quotation, the normal time required for each operation is listed on the estimate sheet (Exhibit "C") and the estimated or normal costs are arrived at by extending the time by the machine hour rate for each operation. To this is added an estimate of the materials required at their actual expected cost. As the board and packaging materials used are the same price from the various suppliers, this is not a difficult task. Selling, administrative and freight costs are then taken into consideration and finally the profit is added.

If the estimate is for a quotation request, a letter is then sent to the prospective buyer, stating price and terms. If it is for an order, a confirmation of order is mailed to the buyer.

When an order is placed into production, the specifications on the estimate sheet are copied onto the production order. The estimated times and costs are copied onto the cost summary, where there is a column for these estimated costs. Then they can easily be compared with the actual costs when the order is completed.

Performance records of the various machines are supplied to the estimator by the cost accountant to assist him in arriving at the normal rate for estimating.

Controls

Production Control and Scheduling

As the orders are received by the production control clerk, the production order and docket are first made up showing all the necessary specifications of the order. The specifications are obtained from one or all of the customer's orders, the estimate sheet and a sample of the carton to be run.

The required time to complete each operation is then plotted on the load board. A small card about 1″ x 2″, showing the order number, customer's name and the delivery date, is inserted in 1″ wide horizontal grooves on the load board. Each card represents one day's work for one machine. Sufficient of these cards for each order are then inserted into the grooves of the board. There is a separate groove for each machine.

The load board is a visual aid in working out a plan to have orders completed as they are required and to make the best possible use of men and machines. The board shows when jobs are to be completed, by whom, and how long it will take. The work ahead for each operation for the following four months is always shown on the board. It is easy to see when delivery can be made and therefore accurate delivery promises can be given.

This information is useful to the sales department for other reasons. When certain types of machines are slack, they can concentrate on orders for these machines and at the same time have orders placed for the busy machines far enough ahead so that the customers will not run out of cartons.

Besides the load board, run sheets are typed showing the work load for a week ahead. These sheets are given to the various supervisors and posted in the plant. In this way the various departments can again check to see that everything is in readiness for the next job.

Average hourly production per week for each machine is posted weekly in order that the foremen and the workers can see it. They are kept aware of any drop in production.

Other reports which are made out and posted for the benefit of the production departments are:

1. Spoilage
2. Orders received (backlog)
3. Allowances to customers
4. Labour costs in dollars
5. Labour costs as a % of production

Quality Controls

Quality control is very important in this business. This duty is performed primarily by the various foremen. The departments are well supervised and the foremen have the time to check frequently the jobs going through production. In printing and cutting and creasing departments, the cartons have to be approved by the foreman responsible,

before production begins.

As all products produced are primarily used for the packaging of food and food products, strict sanitary measures must be taken. The girls who pack the containers also act as inspectors. It is their duty to see that no dirty or poorly manufactured articles are packed. Each case of cartons contains a slip bearing the packer's number. Therefore, if there is a complaint regarding quality, the inspector can easily be identified.

Inventory Control

Most items are produced for the customer's special requirements and only enough raw material is purchased to complete the order. The stockkeeper checks to see that all the materials ordered and received for an order go into production.

There are a few smaller items that are stocked. These are checked to make sure that there is no more than a two month supply on hand at any one time.

Control by Reports

1. *Cost Summaries and Profit and Loss Statements*

The cost summaries for every order and the monthly profit and loss statements are submitted to top management. The department heads are required to supply detailed statements accounting for any variances which are above or below normal. These statements also indicate what corrective action, if any, has been or will be taken.

2. *Accounts Receivable Analysis*

An analysis of the accounts receivable is submitted to the credit department which must take the necessary action on delinquent accounts and bad debts. The credit department is required to give a reason why an account has become delinquent and also to advise what action is being taken to enforce collection.

3. *Cash*

A further report is submitted to the Secretary-Treasurer showing totals of receipts and disbursements, current bank balance, etc., and the anticipated situation for the coming month. This enables the Secretary-Treasurer to be sure of taking appropriate action, as and when necessary, to provide sufficient liquid assets at all times.

4. *Monthly Financial Statements*

The profit and loss statement and the manufacturing statement show the result of operations for the month, the month a year ago, the budget for the month, the budget for the year to date, the year to date this year and the year to date a year ago. With the above figures, a close check is kept on manufacturing overhead, selling, and administrative expenses by management.

5. *Repairs and Supplies Report*

We find that this item requires close attention and a detailed report is made out each month for the manager, listing the various items that have been charged to repairs account.

6. Production Report

A daily report is made up showing the total completed production of the previous day, along with the total of the month to date and the budget figure for the month to date.

Conclusion

It is hoped that this system has conveyed the importance of (a) formulating a plan of operating and (b) working at all times to that plan.

This company's method of ensuring that it does work closely to the plan is by the wise use of cost accounting, adequate controls, intelligent statements, reports and analyses. With the aid of such weapons, the company's management can usually prevent or correct errors and review and adjust policies with sufficient rapidity to be reasonably certain of satisfactory results at the end of the fiscal year.

The main advantage of this accounting system is that it supplies management with sufficient accurate and prompt reports to operate efficiently with a minimum number of clerical employees.

PURCHASE ORDER

PHONE JA 8-1459

ROBINSON INDUSTRIES LIMITED

135 - 145 MCNAB STREET NORTH HAMILTON - ONTARIO

Nº 3063

TO

DATE

DEPARTMENT

ACCOUNT No.

SHIP TO 135 MCNAB ST. NORTH, HAMILTON, ONT. TERMS

REQUIRED VIA F.O.B. HAMILTON, ONT.

PLEASE SUPPLY THE FOLLOWING MATERIAL AT PRICES AND TERMS SPECIFIED

QUANTITY	DESCRIPTION	PRICE

QUANTITY RECEIVED	COMPLETE DESCRIPTION OF GOODS RECEIVED

ROBINSON INDUSTRIES LIMITED

DATE RECEIVED

RECEIVED BY

EXHIBIT "A"

RECEIVER'S COPY 1

ACCEPTANCE OF ORDER

SOLD TO

SALESMAN | SALES TAX | ORDER No.

TERMS: NET 30 DAYS | CUSTOMER'S ORDER No.

F.O.B. | DATE

SHIPPING INSTRUCTIONS

SHIP TO | WHEN

VIA

BILLING INSTRUCTIONS

QUANTITY	SIZE	STYLE	INKS

DESCRIPTION | PRICE

SUBJECT TO PRICE RULING DATE OF SHIPMENT

MATERIAL | PER M

ENGRAVINGS | ENGRAVING COSTS

SPECIAL INSTRUCTIONS

PLEASE READ

THIS ACKNOWLEDGMENT IS MAILED TO YOU FOR THE PURPOSE OF COMPARISON WITH YOUR ORDER. KINDLY NOTIFY US AT ONCE IF INCORRECT, OTHERWISE THE ORDER WILL BE FILLED IN ACCORDANCE WITH THE CONDITIONS OF SALE ON THE REVERSE SIDE HEREOF.

ROBINSON INDUSTRIES LIMITED

SALES DEPARTMENT

DELIVERIES

DATE	No. OF SOLD	CARTONS PER SOL.	QUANTITIES

SIZE

STYLE

COPY

COLOUR

EXHIBIT "B"

FOLDING CARTON DEPARTMENT

JOB COST RECORD

Date

Order No. Description

Customer Design

Address Style

Size

COLOURS BOARD

Quantity Caliper

No. Up Size

Quantity Produced

MATERIALS

	Quantity		Price		Amount			
	Est.	Act.			Est.		Actual	
Board								
Ink								
Ink								
Ink								
Varnish								
Cellophane								
Glue								
Wax								
Paper								
Twine Reg.								
Twine Sax								
Thread Red								
Thread White								
Cases Small								
Cases Large								
Gum Tape								
Die Material								
Electrotypes								
TOTAL								

PARTICULARS

Customers No.

F. O. B.

Delivery

MANUFACTURING

	Hours		Price		Amount			
	Est.	Act.			Est.		Actual	
Board Storage								
Composing								
Die Making								
MR. P.P.								
Run P.P.								
MR. P.P.								
Run P.P.								
MR. C.& C.								
Run C.& C.								
Waxer								
Gluer								
Stripping								
Handwork								
Cellophaning								
TOTAL								

Completed-

	Estimated		Actual	
Material				
Manufact				
Total				
Selling				
Freight				
Total				
S.P.				
Cost				
Profit				
% S.P.				

EXHIBIT "C"

Homogenizing Factory and Office Thinking . . .

By Henry G. Lykken, Jr.,
Comptroller, Minneapolis Division, Minneapolis-Honeywell Regulator Company, Minneapolis, Minnesota

Communications between the accounting and the production departments are seldom all that they should be, owing to the lack of a common language between the two. This article describes how the semantics problem was overcome in one company and how an efficient system of reporting and correlated action was set up to increase production and profits.

IN MANY companies factory management and the accounting department do not function smoothly as a team. This was the case in our company. Both groups had their own problems, and in large measure attempted to solve them within their own orbits. This didn't mean that the factory wasn't getting reports from the accounting department. It was. Each foreman got in the neighborhood of three-quarters of a pound of reports each week.

These reports gave the foreman a vast pot pourri of figures covering events that had happened six weeks before. They were technically correct, prorates were made to the hundredths of a percentage point, and the entire report was a masterpiece of finesse and nicety. The foremen, however, was immune to the nuances of a reversed accrual, even had he been able to recognize one when he saw it. To him the reports read like a foreign language.

Second Guessing Is No Substitute for Knowing

In other words, the accountant was giving to factory management those reports which the accountant thought he needed. For appearances' sake, the foreman accepted the reports graciously and stored them until he thought that no one would ask about them further. As soon as he felt it safe, the foreman quietly slid the bundle of reports into the waste basket.

Some four years ago the factory manager decided that he wanted to use these figures. The accountants were only too glad to sit down and do what they could to help in finding a suitable means of presentation. The joint group decided that there were two basic things wrong:

1. Reports were much too slow.
2. The reports were too complicated and detailed.

Evaluating the Need for a Closer Working Arrangement

This led to a preliminary assessment of the accounting department. In this case, we were dealing almost entirely with that section of the accounting function which is more popularly known as cost accounting. Let's review our past and present concepts of accounting communications.

In every company today, there is a responsibility for accumulating financial information, summarizing this information and presenting it in a manner useful to the owners or prospective investors in the company. This information, with certain modifications, is the same information necessary for the preparation of tax returns and other reports. For purposes of identification let's call this the "line" operation, or the formalized side of accounting. Make no mistake but that this side of accounting is absolutely necessary to the operation of a business.

It was the reports from this line function of accounting that had been going to the factory management. Some of the figures were suitable for operating controls, but by and large, the figures were from some other report and provided little or no information for operating controls. Had the foreman been a trained analyst, he probably could have ferreted out some useful facts. But what was really needed were reports which would highlight the important figures and variances in such a way that red lights for action were clear to the foremen.

This situation gave rise to what we'll term "staff" accounting. This is a group of accountants, with a background in the more formalized side of accounting, who are specially trained to present figures in understandable form to the factory. They are the liaison men between the accounting function and factory management—the interpreters, if you will, transferring accounting figures to factory action.

Some companies, of course, do not have a staff side to their accounting department. This need is filled by such groups within the organization as the industrial engineering department. However, at Minneapolis-Honeywell it was decided that the factory "helping-hand" side of the accounting department would be one of its own members. This decision was based on two compelling considerations:

1. It was the most economical.
2. It was the quickest.

Pinpointing the problem.

As has been mentioned before, production people don't speak the language of the accountant; conversely, the accountants have even less ability to speak the language of the shop superintendent and crew. It was necessary to work out a common ground or means of communication. The first step was to make the foreman aware of his direct and personal responsibility for the expenses in his department. This concept was the focal point of the whole plan.

To train and develop the foreman in the fundamentals of our accounting system took a long time, as much as two years. But it was time well spent, since it was the solid foundation on which the whole system was to be built.

Training the Foremen

A man with some accounting training was assigned full time to an expense forecasting programme. His first duty was to sit down with

each foreman, and, by reviewing the past several months' record, obtain from him a forecast or estimate of expenses in the following months. The basic information that the foreman needed on future production requirements was furnished by the production control department.

This was a period of transition. Several different methods and forms were used before a workable arrangement was reached which would enable the foreman to work out his own forecast. As the *forecasting* plan began its halting way, a corollary set of reports was started. This provided the foreman with a summary of what he had *actually* spent in the preceding months. Here the emphasis was on speed rather than absolute accuracy. It might be given the inelegant term of "quick and dirty" reporting.

In time, the foreman began to forecast his expenses in greater detail. Coincidentally, the report which he got of his actual expenses began to be more and more accurate. The short-cuts in accounting procedures which were so essential to speed were refined and polished. The precision of the forecasting function was thus greatly increased and the information presented in a manner more suitable for control purposes.

So far we have been talking about only the foreman, or the first level of supervision. There was another and parallel programme going on at the same time. This programme was directed to the foreman's direct superiors—the general foreman, the superintendents and the factory manager. Where the individual foreman got figures for each phase of his operation, the general foreman got these same figures but for a large number of departments. To make this a little clearer, Foreman A got the direct labour costs for Department 1. His immediate superior, the general foreman, got the direct labour costs for Departments 1, 2, 3, 4, and 5 in total.

The general foreman's boss, the factory superintendent, received his information in a still more condensed form. However, his information covered a wider area. Therefore, by the time it got up to the factory manager, the reporting structure looked something like a pyramid. There was a broad base of very detailed information which, through refinement, was pointed up into a relatively few number of key figures.

At the beginning, these key figures were kept very simple. Each major item of expense, such as inspection, overtime, maintenance, and tooling were related as a percentage to a single figure—direct labour. The information was plotted on a wall chart mounted in the superintendent's office. For example, he had a single chart for inspection. This chart covered all the inspection departments in the factory. Should the inspection expense get out of line, the factory manager, like the monitor in a TV studio, had only to ask that an evaluation be made by the factory superintendent. The latter could, by following the com-

parison of forecast and actual expenses step-by-step, isolate the department or departments where the out-of-line condition originated.

The foreman's total monthly estimates were posted on this chart. They could then be compared with his actual expenditures. Each foreman was interviewed individually by the superintendent in advance of the period for which the forecast was being prepared.

Reporting Procedure

As the programme developed further, it became increasingly apparent that a serious time lag existed in the reporting of expenses. The individual foreman did not know where he stood with regard to his estimates during the current month. By the time the figures became available, it was too late to take corrective action.

To remedy this situation, a weekly report was devised using the labor cost figures from the weekly time card summaries. This report shows the weekly labour cost in each account and compares it with the foreman's estimate. A month-to-date column, showing cumulative expense versus estimate, is a barometer which quickly highlights those accounts requiring the foreman's immediate attention if he is to stay within his estimate for the month.

Details of the Programme

Three points of the programme deserve to be emphasized:

1. The payroll figures are picked up from the weekly time card summaries. They are not the figures which go into the official accounting records. The margin of error is negligible insofar as control purposes are concerned.
   The very marked advantage in that they are obtained as the month progresses and the total is available on the day after the month ends. It would be necessary to wait three weeks into the following month for official accounting figures.
2. No attempt has been made to tie the factory forecasting programme to our official accounting statement. It is, of course, made up from the same basic data, but, in the interest of speed, many short-cuts are used, minor reconciliations omitted, and prorates between departments ignored.
3. The keynote of the installation was informality. Letters of instruction were kept to a minimum. Much of the work was done by personal contact with both foremen and higher supervision.

Formalizing the Programme

After twenty-four months of laying the groundwork, the time seemed ripe for drawing all the threads together—in a sense, to formalize the programme. This was done at a meeting attended by all who were concerned with the expense forecasting plan—unit supervisors, assistant foremen, foremen, factory superintendents, department heads, accounting department personnel, etc.

The theme of the meeting was the "Big Picture". For the first time we saw the plan as a whole. Previously each foreman had seen only his small part. Now he saw that part in relation to all the others. More important, he saw the role he played as a profit producer. Through charts and slides, the company president, the factory manager and his assistant, the divisional comptroller, and the factory superintendents showed that control was exercised through foremen—the first line of supervision.

As imposing an array of company management men as it was possible to collect was assembled. There is no substitute for the fact that if a man's boss, and his boss' boss, show interest in a project, the man himself is irresistibly drawn to it.

It was emphasized that the basic responsibility was the foreman's —that, step-by-step, the results of his efforts were channeled through successive levels to the factory manager's operating statement.

The ultimate success of such a programme depends upon the enthusiastic and universal participation of all levels of factory management. Foremen and factory supervision incur the costs. They are the people who can ensure that labour, materials, and supplies are used to the best advantage. In addition, the people who use the programme must understand it and must be sold on it. If they are not, the programme cannot work.

The "Little Red School House"

One major step in carrying out our plan was to instruct the factory operating supervisors in some basic accounting procedures and terminology. It was necessary that they have a working knowledge of the various documents they sign and that they understand how these papers produce the cost records of their departments.

Foremen were responsible for production quality, for labour relations, for carrying out company policies, and for many other equally important functions. They were, in general, reluctant to analyze or to use accounting data. This stems, possibly, from a feeling that accounting is a very complex "science".

In addition, the task of cost control is often considered an unpleasant one. As a result, the foreman used to place the study of accounting reports and the task of cost control near the bottom of his list of responsibilities. Instruction convinced foremen of the need for cost control and the value of cost reports.

Basic Indoctrination Sessions

As a follow-up to the "Big Picture" meeting, a series of conferences was held with the foremen. Accounting personnel acted as discussion leaders. These sessions were planned to take the foreman through the detail phases of the programme and to give him a very elementary introduction to the accounting principles involved.

The conferences were of the question-and-answer type. Active participation of the foremen indicated that we were off to a good start. There were several weekly sessions. The groups were kept small enough to allow discussion of individual problems.

To promote further understanding and co-operation in the factory, the report forms were arranged and prepared on the basis of suggestions made by the foremen. In some cases, account descriptions of expense items were changed to express them more clearly in the foremen's language.

Early Results

The first months of application were difficult. In many instances, actual results were nowhere near the forecasts. In the process, we learned a good deal about forecasting; also becoming more convinced of the benefits of planning the future to realize maximum profit.

There was no simple formula which could be applied to all accounts or departments. Even the same type of expense in different departments had different sets of circumstances which governed its change from one period to the next.

Therefore, in projecting an over-all plan, we could not assume any uniform relationship applicable to all departments between items of cost or to production levels.

Emphasis on Speed

At this point it should be recalled that the accounting department was called upon to meet the special needs of the factory operating departments. The new emphasis in records and reports for factory management is not only on accuracy, but on speed as well.

Basically, we report from source documents rather than from published accounting statements. The costs are picked up before they are processed through formal accounting routine. The result is that factory management is furnished with fairly accurate costs within two days following the week in which they are incurred. We are doing what we once felt to be impossible.

The programme is basically simple and straightforward and embodies application of principles deserving of emphasis. The framework of the programme can be summarized as follows:

1. Each department head is held accountable only for the costs which he can actually control.
2. The plans—or goals—or forecasts—or budgets—are created by those who will make the expenditures and can best control them.
3. All major expenditures are decided upon before they are incurred.
4. The reports and accounts are designed to be understood by those who can profit by their use. Normal accounting procedures are by-passed in order to make information quickly available.

Every man in operating management, from the assistant foreman to the factory manager, is actively and constantly working on planning for profits.

Benefits of the Programme

Based on our experience, the following appear to be the essential ingredients of a successful relationship between accounting and the production organization:

Proper atmosphere. The staff accountant exists only to serve the production team and has no responsibility in the line accounting function. In order for this group to be of any value, the production people, and particularly the factory manager, must want the type of help they can give.

Means of Communication. This point is often taken too lightly, especially when accountants and production people are thrown together. In addition to all the foregoing programmes, let's add the practice of having one or two production people in the staff accounting group for six to nine months of special training. When these men return to production supervision, they have become dedicated missionaries carrying the word and helping to build a substantial bridge between these islands.

Flexible Relationship. The staff accountant does not dictate or direct any action. His place is to recommend and assist where help is requested. The staff accountant, by means of his technical training, is able to take liberties with the established accounting practices in accordance with the needs of the operating activity, and still is able to reconcile the work directly into the financial results.

Clearly Defined Objective. The most important ingredient—the objective—should be established by the factory people. The objective in this case, of course, was to provide information on each department's specific contribution to the company's profit. The result is our factory profit-and-loss statement.

We started out with the assumption that there was not a close enough connection between factory management and the accountant. The lack of correlation was resulting in less profits than should be expected. There are several ways in which a closer relationship can be developed. What has been said is only one of these ways. You can say that in setting up a forecasting plan for better profits, the factory management team and the accountant were drawn closer together. Or, from a different viewpoint, it might be said that as a result of drawing the two groups into a closer working arrangement, a better plan for forecasting and arriving at profits was brought into being.

FOR FURTHER READING

WHAT TOP MANAGEMENT AND PRODUCTION MEN WANT FROM THE FINANCE DEPARTMENT, by C. W. Allen, A.M.A. Financial Management Series No. 109.

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PLANNING ORGANIZATION FOR COST CONTROL, by William H. Hopkins, Cost and Management, June 1957.